Appendix E

Integrated Water Resource Plan –

Pennichuck Water Works, September 1998

Integrated Water Resource Plan

A view of the Pennichuck Brook Watershed
With the Merrimack River in the foreground

Pennichuck Water Works, Inc.
September 1998

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Pennichuck's Planning Process

Least cost integrated resource planning is the means by which utilities ensure that they are meeting their customers' needs with the most efficient utilization of society's resources.

Pennichuck Water Works, Inc. uses least cost integrated resource planning to guide the growth and improvement of all systems to ensure reliability of operations while maintaining an affordable cost of service.

The Company prepares an updated three year capital plan each year. The capital plan responds to the forecast of growth for the ensuing years, the implementation of improved technology and to the need for infrastructure rehabilitation and replacement.

Pennichuck follows a logical process to prepare the three-year plan:

- Operating departments prepare a need assessment to identify items necessary to improve service to customers and to improve the efficiency and effectiveness of the department. Also, current facilities and equipment are reviewed to determine the need for rehabilitation and replacement.
- The Engineering Department works with department managers and senior management of the Company to identify new projects, new technologies and programs which will improve the current service level, prepare the operation to meet increased levels of demand and to reduce waste (costs).
- A draft capital budget is prepared along with projected financial statements for the same period.

- Project demands are balanced against available and projected capital availability. Outside financing requirements are then established and a financial plan is prepared.
- The three-year plans are reviewed and approved annually by the Company Board of Directors.

During the course of the year, department managers submit Capital Improvement Requests for each specific project. A copy of the form is attached. The write-up provides all of the pertinent information about the project and the justification for the investment. The justification must include the purpose of the project, the expected benefits and an analysis of alternatives. A cost-benefit analysis is required in most cases. The Officers of the Company must sign off on the project before the manager proceeds.

The Company uses input from USEPA and NHDES to establish plans for capital expenditures to meet the requirements of the Safe Drinking Water Act (SDWA). Compliance-related improvements are reviewed thoroughly with the Water Supply Engineering Bureau of DES to ensure that the project will successfully accomplish the compliance requirement. Alternatives are evaluated to assure that the least-cost, most effective methods are implemented.

Water utilities are very capital intensive. There is always more demand for investment capital funds than is supplied through operations. The Company prepares a projected income statement and cash flow statement to determine the availability of funds from operations for each year in the three year Plan. The Capital Budget is evaluated to determine the need for outside funding. Projects are prioritized to make sure necessary or critical expenditures are provided for and items that are not as critical may be deferred to future years depending upon the availability of funding. The Projected Three Year Capital Budget and related income and cash flow statements are included in this report at Tab #3.

Demand Side Management

Pennichuck is fortunate to have an ample supply of water for its service area. The Pennichuck Brook system is more than adequate to meet demand throughout most of the year. During the summer, demand increases dramatically due to water use for lawn irrigation and other seasonal uses. The Merrimack River provides a supplemental supply to the Pennichuck Brook system during the dry summer periods to help provide adequate supply to meet demand. Pennichuck's sources of supply are covered more fully in the next section of this report.

Drinking water resources need to be managed properly. Water utilities need to take action to discourage wasteful use. The three most common methods to ensure wise usage of water are; 1) customer education, 2) metering and billing based on usage level, 3) water restrictions and enforcement, and, 4) progressive economic pricing.

The Company provides regular mailing inserts to customers to encourage prudent use of their drinking water supply. Pamphlets target the proper use of lawn sprinklers and irrigation systems to establish a healthy lawn without over-watering. Suggestions are provided to help reduce waste of water in every day uses. The educational efforts of the USEPA and water industry associations have been helpful in achieving customer awareness of the practical limits of water supply.

The most effective control over waste is the metering and billing program. Every Pennichuck customer service line is metered and customers are charged for the water they use. The customer's concern for the cost of water (and the related charge for wastewater from the municipality) has been the most effective tool in demand management

Many water utilities around the country are instituting progressive rate schedules where customers who use a large amount of water for seasonal lawn watering pay a higher rate than the rate charged for normal usage levels.

The Company uses restrictions on lawn watering and other outside uses of water when required. The New Hampshire Water Works Association has worked with the NH Department of Environmental Services (DES) to develop a Drought Response Program for the larger water utilities in the state. The Company follows this program as a guideline for instituting restrictions. A copy of the State guidelines and a notice which Pennichuck sent to customers are attached.

The challenge of water use restrictions is enforcement. Voluntary restrictions have a limited impact on demand and mandatory restrictions are only effective when enforced. As resources become more limited in the future, customer education and cooperation will be critical to the success of restriction-type programs.

Demand Forecasting

Demand forecasting is accomplished using several processes. The Company uses historical production data to predict future demand using a simple linear regression calculation. Average day demand is analyzed as well as peak period average day demand. The demand plots are attached as Chart #1. Average daily demand is projected at about 16 million gallons per day (MGD) in 2017 and peak average day is projected at approximately 24 MGD. However, the projections need to take into account other factors such as economic and demographic predictions.

The City of Nashua is approaching full build out. We obtain population data and projections from the City of Nashua and the Nashua Regional Planning Commission, which are incorporated into the forecasts. Chart #2 shows a graph of the population projections used in the forecast. Chart #3 shows the historical data from Chart #1 with projections for the increases in average daily demand based on the projected increase in population. Historical data shows a direct correlation between changes in average daily demand and changes in population. The Company believes that the population demand forecast is the most likely scenario for future demand expectations.

Another factor influencing the demand projections is the customer usage pattern. Chart #4 is a plot of production per service connection since 1970. It is interesting to note the decrease in actual usage per service connection over the period. This decline is attributed to; a) the institution of sewer usage charges based on metered water consumption, b) increases in rates for both water and wastewater services, c) the use of water efficient appliances in new construction and remodeling and, d) a shift away from a local manufacturing economy to a more service-oriented economy.

DROUGHT RESPONSE ACTIONS
NEW HAMPSHIRE PUBLIC WATER SUPPLIERS

The information contained herein is intended to be used as a guideline to assist public water suppliers to implement water reduction and conservation measures during periods of drought. Each public water supply system should consider having its own monitoring and drought response plan tailored to specific local conditions. These measures are presented to correspond with the New Hampshire Drought Management Plan and the severity (level) of the event as determined by NHDES.

Level 1 – Alert

Following notification by NHDES of a Level 1 drought condition, water suppliers should issue public notification of the drought event through radio, television, and newspapers, requesting that the general public voluntarily reduce and conserve water use.

Level 2 – Warning

Following notification by NHDES of a Level 2 drought condition, water suppliers should issue public notification that drought conditions are worsening and the general public is requested to voluntarily reduce water use by 10% to prevent serious shortages.

Level 3 – Emergency

Following notification by NHDES of a Level 3 drought condition, water suppliers should issue public notification that the drought has reached an emergency level and mandatory water conservation is required including, but not limited to, non-essential uses such as lawn watering, car washing, and filling or adding to swimming pools.

Level 4 – Disaster

Following notification by NHDES of a Level 4 drought condition, water suppliers should issue public notification that the drought has reached critical proportions and water suppliers may assess surcharge penalties for non-essential use of water violations and/or excessive use of water.

Pennichuck Water Works, Inc.
Four Water Street PO Box 448 Nashua, NH 03061
603/882-5191 Fax 603/882-4125

Pennichuck declares water emergency

Supply problems trigger conservation measures

For Immediate Release

Wednesday, September 06, 1995

Contact: Maurice L. Arel, President 882-5191 ext. 5300
or Stephen J. Densberger, Executive Vice Pres. 882-5191 ext. 5308

Nashua - Pennichuck Water Works announced today that the continued drought has prompted the Company to institute conservation measures. All customers are being asked to voluntarily restrict their outside uses of water. Requested conservation measures include reducing lawn watering to 1/2 hour per day, eliminate pool refilling, and, if using a hand-held hose to wash your car, make sure that the hose has a shut off nozzle to avoid waste. Customers should limit watering to night time or early morning hours to take maximum advantage of slower evaporation rates.

Pennichuck President, Maurice L. Arel, stated that, "we have been able to keep up with demand all summer, but the absence of any significant rainfall over the past four weeks has finally caught up to us." Pennichuck's customers in the greater Nashua area use an average of about 13 million gallons per day over the course of a year. However, during extended warm, dry summer periods, daily demand skyrockets to 20 - 25 million gallons per day. According to Company rainfall records, the area received only 1.3 inches of rainfall during the month of August versus 5.1 inches in 1994.

Pennichuck uses the Merrimack River as a supplemental supply source through most of the summer. Complicating the current drought is the fact that the operators of the Pawtucket Dam in Lowell, Mass. have opened flood gates to lower the river for repairs to the dam. Pennichuck Water Supply

Manager, Bernard Rousseau said, "The repairs were originally to be made in July but we asked the Lowell Locks and Canal Company to hold off until early fall. Our demand generally drops off during the later part of August but this year has been an exception with the heat and very dry conditions. Now the reduction in the river level impairs our ability to use the river as a supplemental supply." Pennichuck is relying on storage in its pond system to sustain the area until the rains come and the river is restored to normal levels. Repairs at the dam and refilling the impoundment are expected to take three to four weeks.

Pennichuck customers are asked to reduce unnecessary uses and eliminate waste of water as much as possible. Continued drought will lead to an increase in restrictions. According to Mr. Arel, "We will be forced to consider mandatory restrictions and the elimination of all outdoor uses of water if the current conditions continue much longer."

Supply Side Resources

The primary supply of water for Pennichuck Water Works, Inc. is the Pennichuck Brook system. Dams were constructed on the brook during the 1800's to create a chain pond system. The average daily yield of the Pennichuck Brook system is approximately 30 million gallons per day (MGD). The safe yield of Pennichuck, which is the seven-day low flow period during a dry summer period, is 6 MGD. The ponds have over 1 billion gallons of stored water.

In the 1960's, Pennichuck constructed an intake, pumping station and pipeline to pump supplemental water from the Souhegan River to the Pennichuck Brook. The demand during the summer had exceeded the safe yield and the Souhegan supplement provided an additional supply of approximately 5 MGD. The Nashua area continued to experience significant population growth through the 1960's and 1970's. The Souhegan supplement was no longer adequate to keep up with summertime demand and Pennichuck frequently instituted lawn watering bans to preserve limited supplies. An engineering study completed in 1972 recommended that Pennichuck acquire property and construct an intake and pumping station on the Merrimack River with a pipeline to the Pennichuck chain-pond system. The Merrimack was determined to be a more abundant and reliable supply The Merrimack project was constructed in 1984 and the Souhegan supplement was discontinued.

The Merrimack River Supplement (MRS) provides the capability for a supplemental supply of up to 30 MGD. Current pumping equipment consists of a 150 HP and a 300 HP electric pumping unit which allow the Company to pump up to 16.2 MGD from the river to Bowers Pond. The Company's permits allow for a withdrawal of up to 30 MGD and the pumping station was constructed to allow for the addition of a third pumping which will enable the Company to withdraw up to 24 MGD. An additional parallel pipeline between the MRS and Bowers Pond would need to be installed in order to achieve the full supplement of 30 MGD.

In 1990, Pennichuck acquired the Bon Terrain water system in Amherst from Consumers NH Water Co. and the Company acquired the Amherst Village District water system. The Bon Terrain system has an excellent gravel-pack well which provides a yield of 1 MGD. The Amherst Village system also has a gravel-pack well with a yield of .3 MGD.

The present summary of supply capability based on safe yield criteria is as follows:

Source of Supply	Present Capacity (MGD)	Future Capacity With 3rd Pump	Permitted Capacity w/ pipeline
Pennichuck Brook System	6.0	6.0	6.0
Merrimack River supplement	16.2	23.8	30.0
Bon Terrain well	1.0	1.0	1.0
Amherst Village well	0.3	0.3	0.3
Total safe yield supply	**22.5**	**31.1**	**37.3**

The Company's current plans include the installation of the third pump at the Merrimack River station. The loss of one of the current Merrimack pumps would jeopardize the Company's ability to meet peak month demands. The loss of a pumping unit or motor could take more than 60 days to repair or replace which would eliminate 8 or 10 MGD from the supply capability. Average day demand during the summer peak month is approaching 18 MGD and peak day demands approach 24 MGD. The third unit is currently needed as a back-up.

The Company's water treatment plant has a throughput capacity of 35 MGD. Current finished water pumping capacity allows for total throughput of 32 MGD. The plant is capable of meeting the projected peak day demand in 20 years with an 18% safety factor.

Future Supply Considerations

Projections over the next 20 years predict that average day demand will increase to approximately 14 MGD. Average day demand during the peak month is projected to increase to about 20 MGD during the period and we anticipate a peak day demand of 28 MGD. Based on these projections, the only significant supply side project which we anticipate completing during the next 20 years is the addition of the 3rd pumping unit at the Merrimack River supplement

The Company does have a number of options available for future additional sources of supply if one of the current supplies is diminished and for future needs beyond the 20 year planning horizon.

1. Increase the withdrawal from the Merrimack River.

   This option will require permit changes with the Army Corps of Engineers and NHDES. There may be resistance from environmental interests to increased withdrawal levels. Instream flow rules promulgated by the NHDES may inhibit the reliance on the river for future additional sources.

2. Construct additional wells in the Bon Terrain wellfield.

   This is a practical option which would potentially allow for an addition of 2 – 3 MGD. Wellhead protection rules require the acquisition of property or easements and a sewer system should be constructed in the Bon Terrain industrial park to protect the aquifer.

3. Construct additional wells on Pennichuck property near Pennichuck Pond.

   The aquifer near Pennichuck Pond is extensive and well protected by Company-owned property. The potential for the development of a series of gravel-pack wells is excellent. It is undetermined whether withdrawals from wells at this point would result in a reduction in the safe yield of the Pennichuck Brook system.

4. Acquire new well development property along the Nashua River.

   There are several locations in western Nashua and in Hollis along the Nashua River where USGS studies have shown extensive aquifers with good well development potential. The Company will need to purchase the properties or secure easements to avoid the loss of these sites to residential or commercial development.

5. Purchase water from Manchester Water Works.

   Manchester Water Works has an abundant supply of water with the Lake Massabessic watershed. Future interconnections between Manchester and the Pennichuck East system in Litchfield would allow for the transmission of water through Litchfield and Hudson to the Pennichuck Water Works system on the west side of the Merrimack River.

Main Extensions and Over-sizing

Pennichuck uses existing flow and pressure data, hydraulic calculations, projections of demand and computer aided modeling to determine appropriate pipe sizes for new main extensions and for replacement of existing mains. The basic required pipe size pursuant to the Company's tariff is 8-inch. In some cases, a pipe size of less than 8-inch may be appropriate, such as an extension for a short, dead-end street. In those cases where a smaller pipeline may be used, the customer pays for the cost of the actual pipe size used. In other cases, the Company may require a larger pipe size. Typically, an "upsize" will be required if the planned pipeline route is part of a major grid loop where our calculations and modeling program indicate a larger pipe size is needed. The Company pays for the difference in cost of the materials for the larger size over the cost of 8-inch materials. The economic justification for the Company's investment in the upsize is that the upsize investment benefits a broader cross section of customers and the larger customer group is justified in supporting that cost. The cost of the upsize is included in the Company's rate base.

Municipal Fire Protection

Pennichuck Water Works provides fire protection in certain of its retail franchise areas. The Company's tariff allows for the establishment of a fire protection charge based on the length and diameter of the water mains used in the system (the inch-foot calculation) and the number of hydrants in the system. The municipality is responsible for payment of the charges.

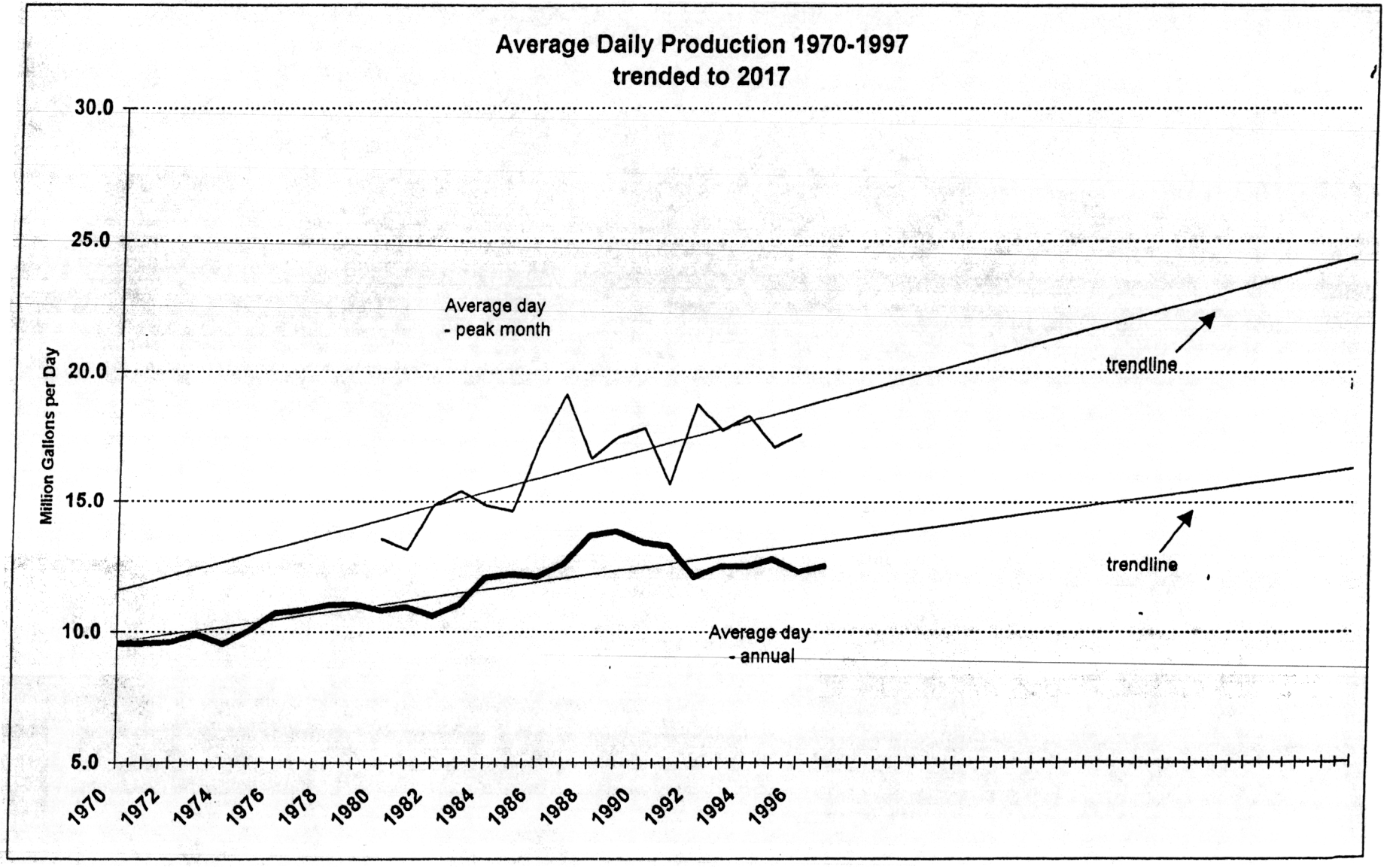
The Company believes that the current policy is appropriate. The municipality should be responsible for the fire protection charge versus only the individual customers who are connected to the water system. Fire protection charges, which are only levied against water customers, ignore the general public benefits and discriminate against the water customers.
Typical municipal fire protection systems provide fire protection to schools, town buildings and other public facilities. Fire departments are able to use the pressurized water system to quickly fill tanker trucks that are used to fight fires in areas of town not served by the water system. A municipal fire protection system generally reduces the insurance rates to many of the properties in the community. Fire protection is a public benefit and the attendant cost is appropriately assessed to the general public of the community served.

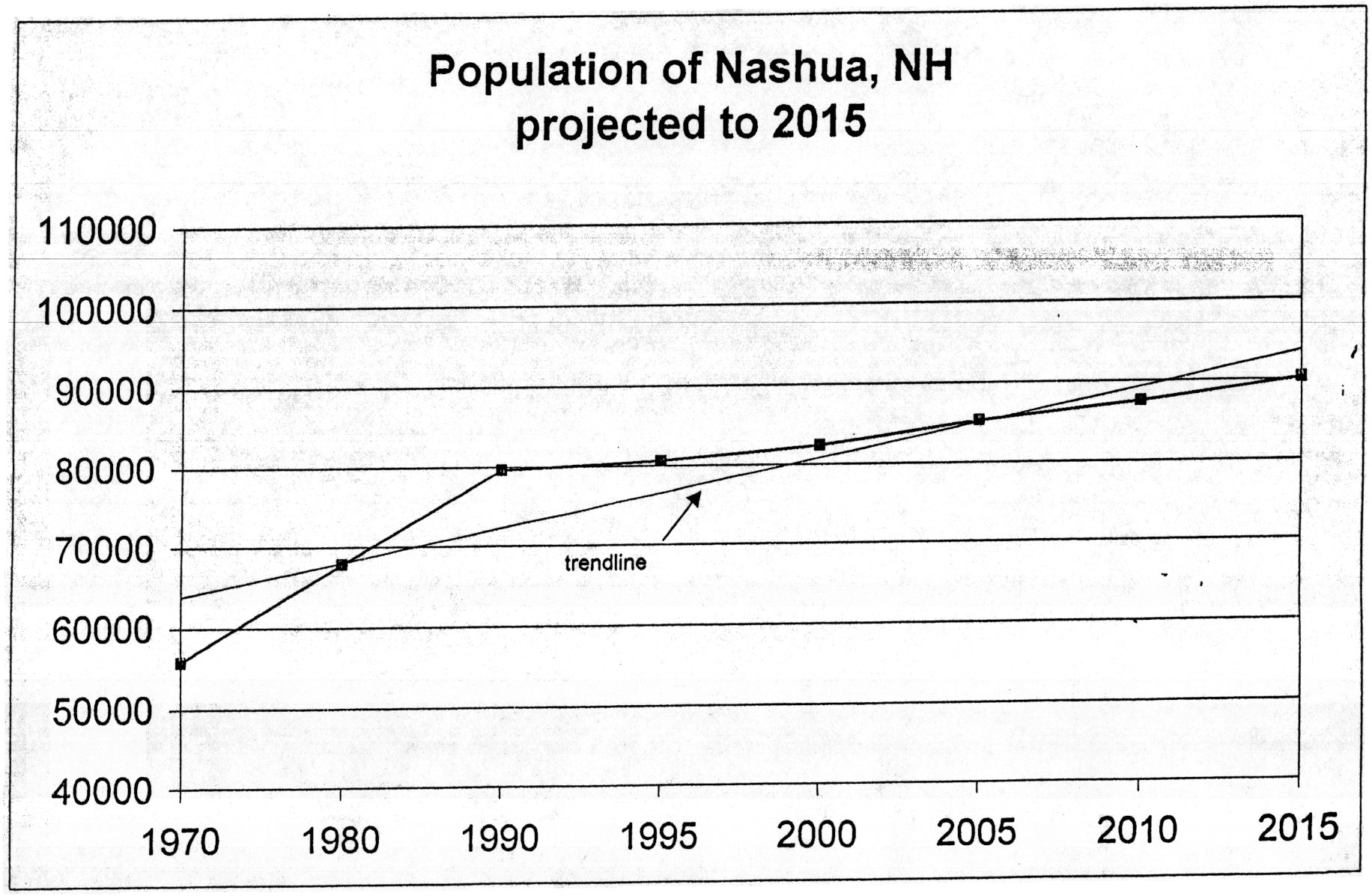
Evaluation of Supply and Demand Resources on a Combined Basis

The Company will evaluate the costs of various supply options for future sources of supply and will endeavor to develop those with the greatest benefit per dollar invested. At the same time, the Company will explore demand management options which will help to reduce unnecessary investment.

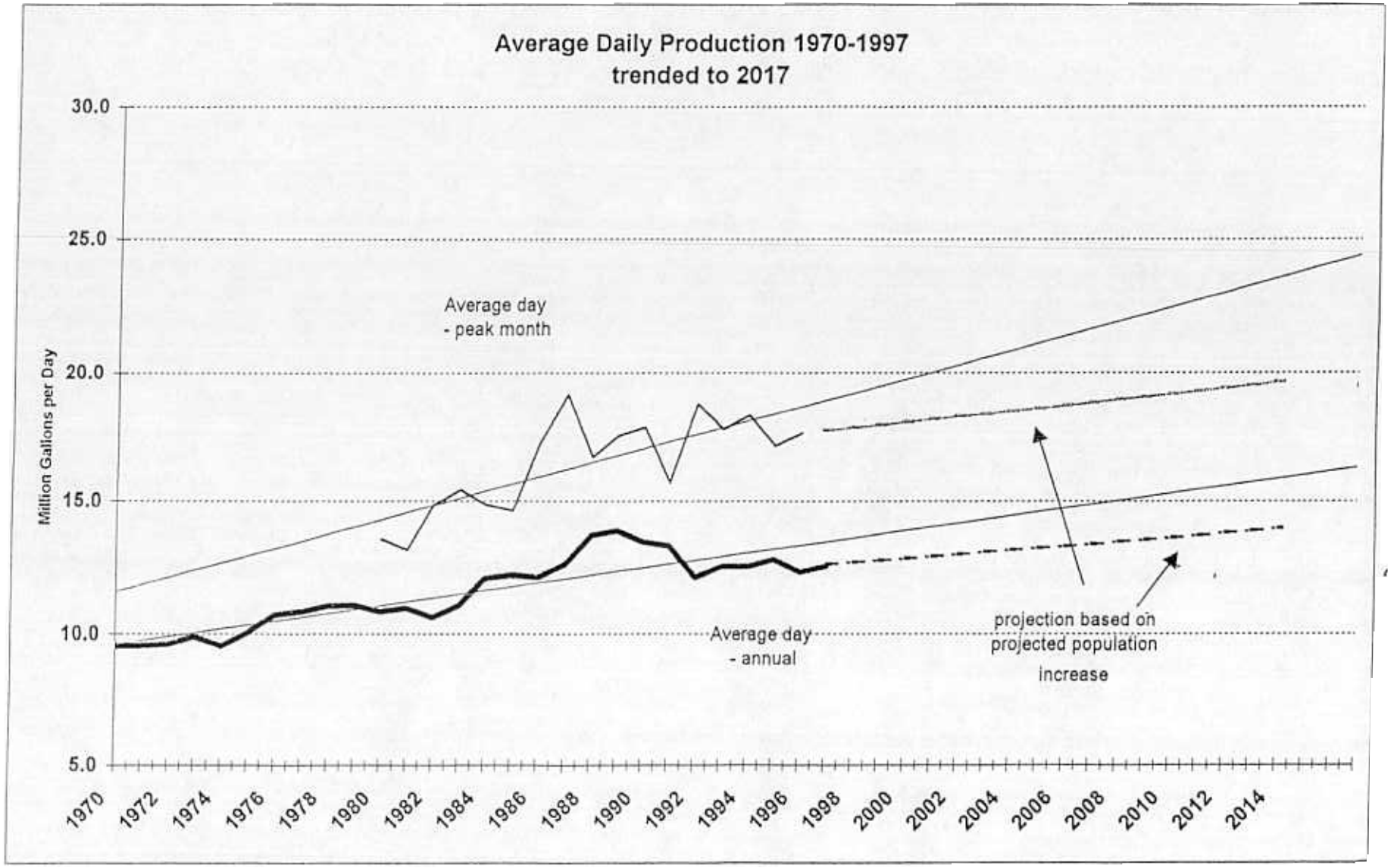
The greatest challenge will be to alter customer expectations in the future for summertime usage. Current supplies are more than adequate to meet current average daily demand, current summertime demand and the demands currently projected in this report. If current supplies are diminished for any reason, the Company would need to seek additional supplies to meet peak period demands.

Peak month, peak day and peak hour requirements are the most difficult to meet and the highest cost both in terms of capital and operating costs. These peak demands are also the most taxing on available sources. A serious demand management strategy could preclude the need for additional supplies for many years. Such a strategy will need to reflect the high cost of peak period demand in the rates and charges for peak utilization in order to be truly effective.


Average Daily Production 1970-1997
trended to 2017
Million Gallons per Day
30.0
25.0
20.0
15.0
10.0
5.0
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
Average day
- peak month
trendline
trendline
Average day
- annual



Sources: Nashua Master Plan Update,
NH Office of State Planning Municipal Population Projections


Average Daily Production 1970-1997
trended to 2017
Million Gallons per Day
30.0
25.0
20.0
15.0
10.0
5.0
Average day
- peak month
Average day
- annual
projection based on
projected population
increase
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

Pennichuck Water Works

Chart #4

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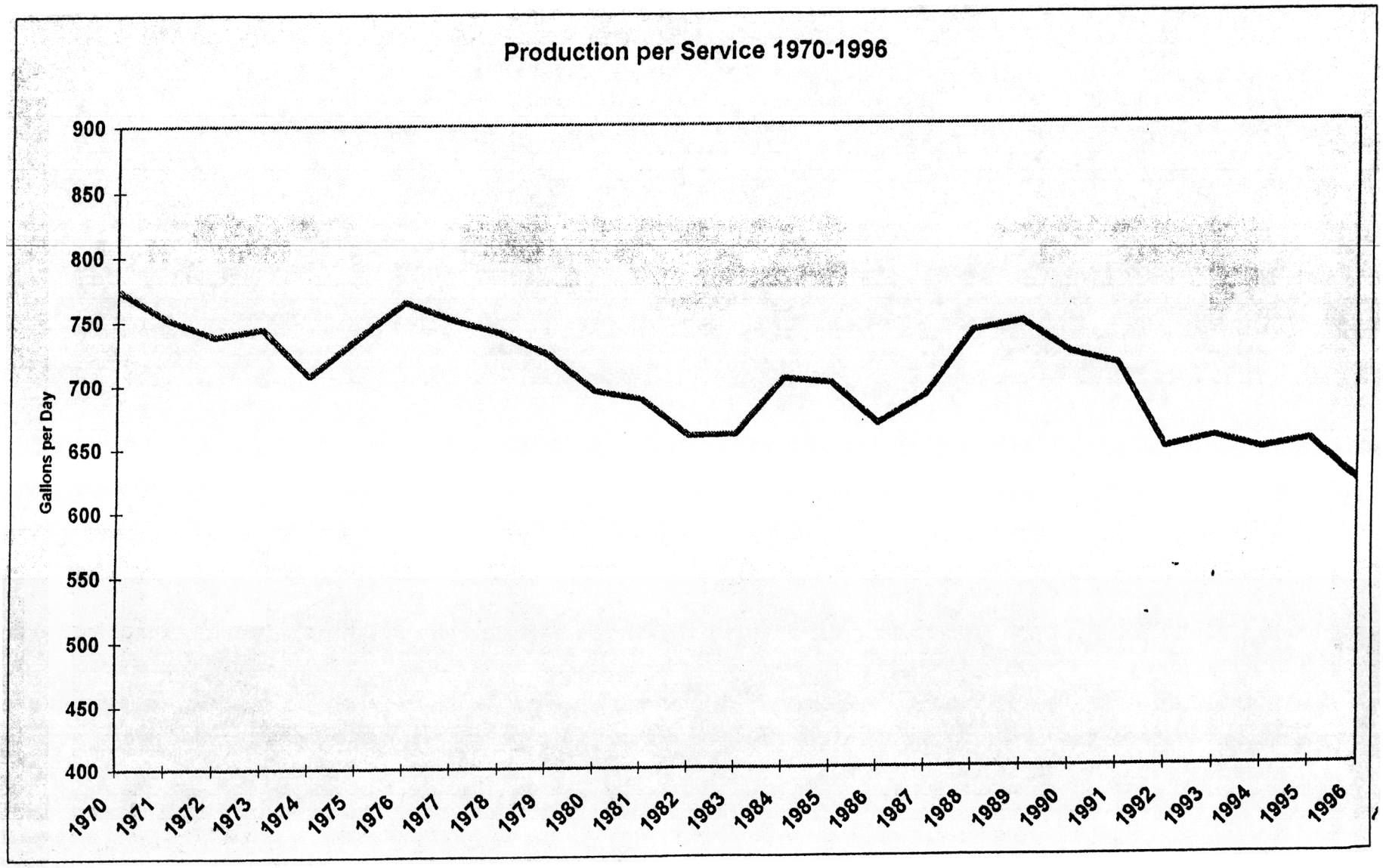

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Projected Three Year Capital Budget
Pennichuck Corporation and Subsidiaries
1998 Through 2001
(In thousands of dollars)

	1998	1999	2000	2001	Cumulative Totals
Supply & Watershed:					
Holt Dam & Dredging	530				
Supply Pond Dam			400		
Route 101A Stormwater Drainage	200	40			
Merrimack River - 3rd Pump		230			
Harris Pond Intake & Flashboards			50	350	
Bon Terrain Pump			125		
Other			-	50	
Supply & Watershed	730	270	575	400	$
Treatment Improvements:					
SCADA - Phase III/V		50			
VariDrive Pumps	304				
Filter Bed Improvements		750			
Lime Dust Collector				80	
Spray Irrigation/Lagoons		210			
Backwash to Waste				150	
Replace AC Pipe in Pulsators				80	
Various Pump Upgrades & Equipment	35	215	260	125	
Treatment Improvements	339		260	435	$
Distribution Infrastructure Replacement:					
Combined Sewer Overflow Replacements	500	500	1,000	1,000	
Broad Street - 16" Main		360			
East Dunstable - 12" Main		100			
Cheshire Street - 12" Main		55			
Main Street - Valve Replacements		30	30	70	
Cleaning & Lining		100	100	100	
Edith Ave	-	60	-	-	
Infrastructure Replacement	500	1,205	1,130	1,170	$ 4,005
Distribution & Storage:					
Ongoing Routine Projects	450	400	400	400	
Daniel Webster Hwy Pump		250			
AVD Tank Line Replacement			56		
Sky Meadow Pumps	81				
Storage Tank Maintenance		20	525	250	
NHDOT Projects	218	40			
Other	45	-	-	-	
Distribution & Storage			981	650	$ 3,135
Community Water Systems	179	345	70	70	$ 664
Pittsfield Aqueduct Company	151	93	82	82	$ 408
Pennichuck East Utility	600	250	250	250	$ 1,350
Data Processing & Administration	300	300	325	370	$ 1,295
Grand Total	3,593	4,398	3,673	3,427	$ 15,091
Cost Inflator	100.0%	102.2%	104.4%	106.7%	
Adjusted Capital Expenditure Cost	$ 3,593	$ 4,495	$ 3,836	$ 3,658	$ 15,582

Historical and Projected Consolidated Statements of Income
Pennichuck Corporation and Subsidiaries

	1997	1998	1999	2000	2001
Revenues:					
Utility	$ 11,200	$ 14,326	$ 15,449	$ 15,721	$ 16,906
Non-regulated water	126	416	589	606	624
Real Estate	514	427	935	588	712
	11,840	15,169	16,973	16,915	18,242
Expenses:					
Operations & Maintenance	5,027	6,471	7,415	7,638	7,867
Depreciation	1,424	1,673	1,881	1,979	2,067
Amortization of CIAC	(127)	(118)	(117)	(116)	(115)
Other Amortization	-	76	76	76	76
Taxes Other	1,518	1,878	1,878	1,878	1,878
Total Utility Expenses	7,842	9,980	11,134	11,455	11,773
Southwood Property Taxes	80	80	65	65	65
Allocated Cost of Land Sales	-	-	-	-	-
Other Expenses	64	222	195	196	197
	7,986	10,282	11,394	11,716	12,035
Earnings Before Interest and Taxes	3,854	4,887	5,580	5,199	6,207
Interest Expense	1,745	2,241	2,393	2,401	2,530
Debt Amortization	29	30	31	32	33
	1,774	2,271	2,424	2,433	2,563
Pretax Income	2,080	2,616	3,156	2,766	3,644
Income Taxes	790	988	1,199	1,050	1,384
Net Income	$ 1,290	$ 1,628	$ 1,957	$ 1,715	$ 2,260
Earnings Per Share	$ 1.72	$ 2.00	$ 2.39	$ 2.08	$ 2.71
Dividends Per Share	$ 1.06	$ 1.14	$ 1.20	$ 1.26	$ 1.32

Statement of Cash Flows
Pennichuck Corporation and Subsidiaries
Calendar Years 1997 Through 2001

	1997	1998	1999	2000	2001
Net Income	$ 1,290	$ 1,628	$ 1,957	$ 1,715	$ 2,260
Depreciation & amortization	1,325	1,659	1,868	1,967	2,056
Deferred income taxes	342	342	342	342	342
Operating Cash Flow	2,957	3,629			
Plant additions	(5,299)	(11,304)	(4,495)	(3,836)	(3,658)
Other	11	460			
CIAC	101	110	112	117	125
Investing Cash Flow	(5,187)	(10,734)	(4,382)	(3,719)	(3,533)
Repayment of principal	(819)	(100)	(100)	(3,333)	(333)
Dividend payments	(794)	(927)	(982)	(1,039)	(1,100)
Proceeds from new debt		7,500	-		
Proceeds from new equity		-	-		
Proceeds from dividend reinvestment	163	139	147	147	156
Preferred stock redemption	-	-	-	-	-
Financing Cash Flow					(1,277)
Projected Annual Cash Flow	$ (3,680)	$ (493)	$ (1,149)	$ (3,919)	$ (151)
Cumulative Short Term Debt	$ (3,680)	$ (4,173)	$ (5,322)	$ (9,241)	$ (9,392)

Growth and Community Character

The Nashua area is presently experiencing rapid development. Some of the smaller communities in the region have expressed concerns about retaining their small-town character in the face of this development. Some of these communities have also expressed concerns about housing affordability for existing residents. This article reviews some of the common techniques used for community preservation in our smaller communities. Zoning standards from some of the NRPC communities are used as examples of what smaller towns are doing to retain their rural characteristics, and how others are addressing the issue of housing affordability. NRPC will be updating its Housing Needs Assessment for the region in the near future so more information will be available on the topic.

Between 1960 and 1996, the population of the NRPC region has increased from 63,920 to 182,020, an increase of 185 percent. During this same period, the State of New Hampshire increased from 606,900 to the current estimated population of 1,162,000. In terms of the total number of housing units, the Nashua region has increased 8 percent between 1990 and 1997, to its current total of 71,799. This is compared to 7 percent for the state. This article surveys how some of the communities in the region have responded to the issue of community preservation.

Community character can be difficult to define. Towns that forced to think about their character and growth are typically se that are currently undergoing the suburbanization process.

Population Growth Since 1960

Town/Location	1996 Population	1960 Population	% Change 1960-1996	% Change 1990-1996
Amherst	9,663	2,051	371%	7%
Brookline	3,128	795	293%	30%
Hollis	6,481	1,720	277%	14%
Hudson	21,072	5,876	259%	8%
Litchfield	6,540	721	807%	19%
Lyndeborough	1,414	594	138%	9%
Merrimack	23,200	2,989	676%	5%
Milford	12,660	4,863	160%	7%
Mont Vernon	1,960	585	235%	8%
Nashua	82,285	39,096	110%	3%
Pelham	10,374	2,605	298%	10%
Wilton	3,243	2,025	60%	4%
NRPC Region	182,020	63,920	185%	6%
State of NH	1,162,000	606,900	91%	5%

Source: US Census; 1996 data is an estimate from the Office of State Planning

There are numerous elements that define community character. The physical attributes of a community such as dirt roads, viewsheds, historic buildings and centers, and stone walls give each community its sense of place. The people who live in a town also add to its character and identity. Growth inevitably leads to change. The challenge of managing growth in a manner consistent with traditional town characteristics defines the issue. The following are variables that need to be considered:

- Density/Build-Out. Density, defined as the number of dwelling units per acre, is the key variable when discussing the development of smaller communities. Build-out is the total number of new structures that can be accommodated in a community, given current zoning and development constraints. The number of dwelling units permitted per acre will determine how any town will build-out over time. A town can expect greater impacts associated with growth depending upon the level of build-out. In general, communities can dictate their desired density if they can demonstrate a purpose through the town's master plan. In the Nashua Region, about half of all communities have zoning densities of one dwelling unit per acre. Many have a minimum density of one dwelling unit per two acres, with some towns implementing five acre zoning in certain areas. Issues surrounding density need to be balanced with concerns about property rights and housing affordability.

- Increased Land Value. While requiring lower densities will help to preserve the physical characteristics of a community, it can also have the effect of driving up land costs per dwelling unit. The result could mean that long standing members of the community would be priced out of the housing market. It could also mean that children would have no opportunities to build on a portion of their parent's land, forcing them to find housing outside of the community. This is a very real concern for many communities that must be addressed. The law makes no differentiation between a developer and a long-time resident who wants to split lots for his children or grandchildren. Likewise, zoning provisions designed to slow growth can also have the effect of forcing out senior citizens who do not desire to care for a large home, but who would like to remain in town.

- Road Frontage. Road frontage can be a key variable in the preservation of rural character. When there are fewer lots on existing roadways, development will be forced away from country roads, thus preserving their character.

- Road Characteristics. Is current zoning requiring the suburbanization of your town? Often times, road standards are based

continued

(published by NRPC)

TABLE I - 1

POPULATION OF THE SOUTHWEST QUADRANT: 1970 - 1990					
POPULATION	1970	1980	%Change 70' - 80'	1990	% Change 80' - 90'
THE SOUTHWEST QUADRANT *	9,700	15,611	61 %	20,483	31.2 %
THE CITY OF NASHUA	55,820	67,865	21.6 %	79,662	17. 4 %
% S.W. QUAD OF TOTAL CITY POPULATION	17.7 %	23 %		25.7 %	

NOTES: The Southwest Quadrant * is defined as Census Tracts 112, 113, 114 and 115 for purposes of this table. The area of these census tracts closely approximates the total area of the Southwest Quadrant. The source of all information is the United States Census.

As seen above, during the last two decades the population of the southwest quadrant has grown at a much faster rate than the population of the entire city. The population of the southwest quadrant increased by 61% between 1970 and 1980 and by 31.2 % between 1980 and 1990. During the same periods, the population of the city increased by 21.6 % and 17.4 %, respectively. During this period, the percentage of the city's residents living in the southwest quadrant increased from nearly 18% to nearly 26%.

Map I - 4 on the next page shows the sequence of development in Nashua from 1980 to 1994. Many subdivisions in the southwest quadrant designated as "Residential Subdivisions, 1980 - 1985", were actually started in the 1970's, but were completed in the early 1980's. This slight delay in dating also applies to the other time periods. Subdivisions were placed in the time period during which they were nearing completion. Many of the larger subdivisions were constructed in phases, with some phases completed in the late 1970's, with more to follow in the early 1980's. In any event, the southwest quadrant has experienced an enormous amount of residential growth in the last two decades. As this Plan will show, much more change is possible by the time this quadrant becomes built-out, even if the rate of growth is slower than in the past.

(from City of Nashua master plan update - 1998)

MUNICIPAL POPULATION PROJECTIONS
1995 to 2015
prepared by the New Hampshire
Office of State Planning

GRAFTON COUNTY	1990 U.S. CENSUS	1995 POP	2000 POP	2005 POP	2010 POP	2015 POP
Monroe	746	792	845	884	926	957
Orange	237	254	271	287	303	313
Orford	1008	1014	1029	1039	1052	1087
Piermont	624	627	628	668	687	710
Plymouth	5811	5971	6205	6376	6559	6773
Rumney	1446	1522	1619	1686	1751	1809
Sugar Hill	464	468	469	499	513	530
Thornton	1505	1760	2049	2259	2442	2522
Warren	820	876	949	998	1052	1087
Waterville	151	151	151	161	165	171
Wentworth	630	661	702	728	758	783
Woodstock	1167	1178	1180	1254	1291	1334
County Total	74929	76845	79582	82463	84971	87502

HILLSBOROUGH COUNTY	1990 U.S. CENSUS	1995 POP	2000 POP	2005 POP	2010 POP	2015 POP
Amherst	9068	9518	10073	10713	11280	11925
Antrim	2360	2306	2309	2366	2396	2383
Bedford	12563	13529	14865	16041	16929	17632
Bennington	1236	1387	1574	1735	1837	1913
Brookline	2410	2748	3117	3507	3873	4266
Deering	1707	1968	2234	2509	2720	2852
Francestown	1217	1352	1537	1696	1837	1913
Goffstown	14621	14900	15625	16448	17041	17839
Greenfield	1519	1527	1617	1701	1762	1845
Greenville	2231	2241	2371	2495	2586	2707
Hancock	1604	1734	1904	2083	2196	2287
Hillsborough	4498	4548	4813	5066	5249	5496
Hollis	5705	6044	6449	6836	7177	7568
Hudson	19530	20233	21157	23465	25614	27939
Litchfield	5516	6099	6749	7798	8795	9852
Lyndeborough	1294	1331	1382	1466	1540	1625
Manchester	99567	100664	102418	102676	102662	102755
Mason	1212	1387	1574	1735	1877	1955
Merrimack	22156	23440	24981	26991	28819	30847
Milford	11795	12246	12831	13573	14224	14974
Mont Vernon	1812	1922	2052	2246	2424	2619
Nashua	79662	80604	82419	85264	87543	90288
New Boston	3214	3781	4467	5051	5510	5739

				9/21/98
Population data				
Nashua, NH				
				Average
				annual
			% increase	increase
1970		55820		
1980		67865	21.6%	2.2%
1990		79662	17.4%	1.7%
1995		80604	1.2%	0.2%
2000	(est.)	82419	2.3%	0.5%
2005	(est.)	85264	3.5%	0.7%
2010	(est.)	87543	2.7%	0.5%
2015	(est.)	90288	3.1%	0.6%
Average annual increase 1980-2015				0.7%
		1995-2015		0.5%
source: NH Office of State Planning, NRPC				

Pennichuck Water Works Average Daily Production 1970-2001 trended to 2015